Hypoalbuminemia is a risk factor for 30-day morbidity after laparoscopic Roux-en-Y gastric bypass

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INTRODUCTION

Despite an excess in adiposity, patients undergoing laparoscopic Roux-en-Y gastric bypass (LRYGB) may be protein-calorie malnourished preoperatively. Preoperative serum albumin levels represent a surrogate for nutritional status, and are frequently obtained. As suggested by prior reports, the aim in this investigation is to use the 2017 ACS-MBSAQIP dataset to discern the role of hypoalbuminemia in 30-day outcomes after LRYGB.

METHODS

22,345 patients who underwent LRYGB and met inclusion criteria were reviewed. Outcomes assessed were 30-day reoperation, readmission, reintervention, mortality and a composite representing the occurrence at least one of these four events. Patient and surgeon factors associated with the endpoints were identified, and multivariate analyses were performed to determine whether serum albumin constituted an independent predictor of any of the outcomes.

RESULTS

Patient Variable	Prevalence/Median (IQR) (n=22,345)
Female	17,966 (80.4)
Age (years)	45.1 (36.3-53.9) (n=22,339)
Non-white race	3,495 (15.6%) (n=20,717)
Initial BMI (kg/m^2)	44.5 (40.4-50.1) (n=22,247)
GERD	8,885 (39.8)
Any Cardiac History	767 (3.4)
Severe Hypertension	2,739 (12.3)
HLD	6,320 (28.3)
DVT	429 (1.9)
History of Venous Stasis	245 (1.1)
Renal Insufficiency	169 (0.5)
Therapeutic Anticoagulation	671 (3.0)
Previous Obesity/Foregut Surgery	342 (1.5)
Diabetes Mellitus	7,883 (35.3)
Tobacco Use	1,900 (8.5)
Non-Independent Functional Status	228 (1.0)
COPD	441 (2.0)
PE	291 (1.3)
OSA	9,819 (43.9)
Chronic Steroids	376 (1.7)
Previous Organ Transplant	17 (0.08)
Albumin	4.0 (3.8-4.3)
Hematocrit	40.9 (38.7-43.2) (n=22,099)
Creatinine	0.80 (0.70-0.90) (n=21,885)
Bariatric Surgeon	22,059 (98.7)
30-day Endpoints	
Reoperation	474 (2.1)
Readmission	1,212 (5.4)
Reintervention	466 (2.1)
Mortality	40 (0.2)
Collective Endpoint	1,623 (7.3)

Table 1- Baseline Characteristics of the Study Cohort

Continuous variables are expressed as median (interquartile range), and categorical variables are expressed as number (percentage)

Patient Variable	Prevalence with 30-day Reoperation (n=474, 2.1%)	Prevalence without 30-day Reoperation (n=21,871, 97.9%)	Odds Ratio (95% CI)	P
Albumin (g/dL)	4.1 (3.7-4.3)	4.0 (3.8-4.3)	n/a	.83
Female	373 (78.7)	17,593 (80.4)	0.90 (0.72, 1.1)	.35
Age (years)	47.0 (37.3-55.9)	45.1 (36.3-53.9)(n=21,865)	n/a	.01
Non-white race	82 (18.1)(n=452)	3,413 (16.8)(n=20,265)	1.1 (0.86, 1.4)	.45
Initial BMI (kg/m^2)	43.8 (40.1-49.7)(n=472)	44.5 (40.4-50.2)(n=21775)	n/a	.08
GERD	218 (46.0)	8,667 (39.6)	1.3 (1.08, 1.6)	.006
Any Cardiac History	27 (5.7)	740 (3.4)	1.7 (1.2, 2.6)	.01
Severe Hypertension	62 (13.1)	2,677 (12.2)	1.08 (0.82, 1.4)	.57
HLD	168 (35.4)	6,152 (28.1)	1.4 (1.2, 1.7)	<.001
DVT	14 (3.0)	415 (1.9)	1.6 (0.92, 2.7)	.12
History of Venous Stasis	4 (0.8)	241 (1.1)	0.76 (0.30, 2.0)	.82
Renal Insufficiency	5 (1.1)	164 (0.7)	0.14 (0.062, 0.33)	<.001
Therapeutic Anticoagulation	21 (4.4)	650 (3.0)	1.5 (0.97, 2.4)	.07
Previous Obesity/Foregut Surgery	16 (3.4)	326 (1.5)	2.3 (1.4, 3.8)	.003
Diabetes Mellitus	172 (36.3)	7,711 (35.3)	1.05 (0.87, 1.3)	.66
Tobacco Use	54 (11.4)	1,846 (8.4)	1.4 (1.04, 1.9)	.03
Non-Independent Functional Status	9 (1.9)	219 (1.0)	1.9 (1.02, 3.7)	.06
COPD	20 (4.2)	421 (1.9)	2.2 (1.4, 3.5)	.002
PE	10 (2.1)	281 (1.3)	1.7 (0.86, 3.1)	.14
OSA	218 (46.0)	9,601 (43.9)	1.01 (0.91, 1.3)	.37
Chronic Steroids	22 (4.6)	354 (1.6)	3.0 (1.9, 4.6)	<.001
Previous Organ Transplant	0 (0.0)	17 (0.08)	-	n/a
Hematocrit	40.8 (38.5-43.3)(n=472)	40.9 (38.7-43.2)(n=21627)	n/a	.75
Creatinine	0.80 (0.70-0.93)(n=470)	0.80 (0.70-0.90)(n=21415)	n/a	.004
Bariatric Surgeon	467 (98.5)	21,592 (98.7)	0.86 (0.42, 1.8)	.68

Table 2- Bivariate Analysis of 30-day Reoperation

Patient Variable	Prevalence with 30-day Readmission (n=1,212, 5.4%)	Prevalence without 30-day Readmission (n=21,133, 94.6%)	Odds Ratio (95% CI)	P
Albumin (g/dL)	4.0 (3.7-4.3)	4.0 (3.8-4.3)	n/a	.005
Female	992 (81.8)	16,974 (80.3)	1.1 (0.95, 1.3)	.21
Age (years)	45.5 (36.5-54.4)(n=1,211)	45.1 (36.3-53.9)(n=21,128)	n/a	.26
Non-white race	245 (21.8)(n=1,122)	3,250 (16.6)(n=19,595)	1.3 (1.1, 1.5)	.001
Initial BMI (kg/m^2)	43.9 (40.1-50.3)(n=1,207)	44.5 (40.4-50.1)(n=21,040)	n/a	.39
GERD	573 (47.3)	8,312 (39.3)	1.4 (1.2, 1.6)	<.001
Any Cardiac History	62 (5.1)	705 (3.4)	1.6 (1.2, 2.0)	.002
Severe Hypertension	176 (14.5)	2,563 (12.1)	1.2 (1.04, 1.5)	.02
HLD	383 (31.6)	5,937 (28.1)	1.2 (1.04, 1.3)	.01
DVT	41 (3.4)	388 (1.8)	1.9 (1.3, 2.6)	<.001
History of Venous Stasis	13 (1.1)	232 (1.1)	0.98 (0.56, 1.7)	1.0
Renal Insufficiency	18 (1.5)	151 (0.71)	2.1 (1.3, 3.4)	.006
Therapeutic Anticoagulation	56 (4.6)	615 (2.9)	1.6 (1.2, 2.1)	.001
Previous Obesity/Foregut Surgery	32 (2.6)	310 (1.5)	1.8 (1.3, 2.6)	.003
Diabetes Mellitus	446 (36.8)	7,437 (35.2)	1.07 (0.95, 1.2)	.27
Tobacco Use	103 (8.5)	1,797 (8.5)	1.00 (0.81, 1.2)	1.0
Non-Independent Functional Status	24 (2.0)	204 (0.97)	2.1 (1.4, 3.2)	.002
COPD	35 (2.9)	406 (1.9)	1.5 (1.1, 2.1)	.03
PE	29 (2.4)	262 (1.2)	2.0 (1.3, 2.9)	.002
OSA	558 (46.0)	9,261 (43.8)	1.1 (0.97, 1.2)	.14
Chronic Steroids	36 (3.0)	340 (1.6)	1.9 (1.3, 2.6)	.001
Previous Organ Transplant	2 (0.17)	15 (0.07)	2.3 (0.53, 9.4)	.23
Hematocrit	40.6 (38.2-42.8)(n=1,202)	40.9 (38.7-43.2)(n=20,897)	n/a	.001
Creatinine	0.80 (0.70-0.93)(n=1,198)	0.80 (0.70-0.90)(n=20,687)	n/a	<.001
Bariatric Surgeon	1,191 (98.3)	20,868 (98.7)	0.72 (0.47, 1.1)	.15

Table 3- Bivariate Analysis of 30-day Readmisssion

Patient Variable	Prevalence with 30-day Reintervention (n=466, 2.1%)	Prevalence without 30-day Reintervention (n=21,879, 97.9%)	Odds Ratio (95% CI)	P
Albumin (g/dL)	4.0 (3.8-4.3)	4.0 (3.8-4.3)	n/a	.71
Female	383 (82.2)	17,583 (80.4)	1.04 (0.90, 1.2)	.62
Age (years)	44.1 (35.8-52.9)	45.1 (36.3-53.9)(n=21,873)	n/a	.27
Non-white race	81 (18.3)(n=443)	3,414 (16.8)(n=20,274)	1.2 (0.94, 1.5)	.15
Initial BMI (kg/m^2)	44.1 (35.8-52.9)	44.5 (40.4-50.1)(n=21,781)	n/a	.33
GERD	218 (46.8)	8667 (39.6)	1.4 (1.1, 1.6)	.002
Any Cardiac History	27 (5.8)	740 (3.4)	1.8 (1.2, 2.6)	.009
Severe Hypertension	63 (13.5)	2676 (12.2)	1.1 (0.86, 1.5)	.39
HLD	146 (31.3)	6174 (28.2)	1.2 (0.95, 1.4)	.15
DVT	13 (2.8)	416 (1.9)	1.5 (0.84, 2.5)	.17
History of Venous Stasis	6 (1.3)	239 (1.1)	1.2 (0.56, 2.5)	.65
Renal Insufficiency	2 (0.4)	167 (0.8)	0.56 (0.13, 2.0)	.59
Therapeutic Anticoagulation	24 (5.2)	647 (3.0)	1.8 (1.2, 2.7)	.01
Previous Obesity/Foregut Surgery	15 (3.2)	327 (1.5)	2.2 (1.3, 3.7)	.007
Diabetes Mellitus	167 (35.8)	7,716 (35.3)	1.03 (0.85, 1.2)	.81
Tobacco Use	40 (8.6)	1,860 (8.5)	1.01 (0.73, 1.4)	.93
Non-Independent Functional Status	3 (0.6)	225 (1.0)	0.62 (0.21, 1.8)	.64
COPD	11 (2.4)	430 (2.0)	1.2 (0.67, 2.1)	.50
PE	11 (2.4)	280 (1.3)	1.9 (1.03, 3.4)	.06
OSA	217 (46.6)	9602 (43.9)	1.1 (0.93, 1.3)	.26
Chronic Steroids	15 (3.2)	361 (1.7)	2.0 (1.2, 3.3)	.02
Previous Organ Transplant	0 (0.0)	17 (0.08)	,	1.0
Hematocrit	40.5 (38.4-43.0)(n=463)	40.9 (38.7-43.2)(n=21,636)	n/a	.02
Creatinine	0.80 (0.70-0.91)(n=458)	0.80 (0.70-0.90)(n=21,427)	n/a	.07
Bariatric Surgeon	459 (98.5)	21,600 (98.7)	0.85 (0.41, 1.8)	.67

Table 4- Bivariate Analysis of 30-day Reintervention

Patient Variable	Prevalence with 30-day Mortality (n=40, 0.2%)	Prevalence without 30-day Mortality (n=22,305, 99.8%)	Odds Ratio (95% CI)	P
Albumin (g/dL)	4.0 (3.7-4.1)	4.0 (3.8-4.3)	n/a	.13
Female	24 (60)	17,942 (80.4)	0.36 (0.20, 0.69)	.003
Age (years)	47.9 (43.8-62.4)	45.1 (36.3-53.9)(n=22,299)	n/a	.002
Non-white race	12 (31.6)(n=38)	3,483 (16.8)(n=20,680)	2.3 (1.2, 4.5)	.03
Initial BMI (kg/m^2)	49.3 (43.1-57.9)	44.5 (40.4-50.1)(n=22,207)	n/a	.003
GERD	21 (52.5)	8,864 (39.7)	1.7 (0.01, 3.2)	.11
Any Cardiac History	7 (17.5)	760 (3.4)	6.0 (2.6, 13.7)	<.001
Severe Hypertension	11 (27.5)	2,728 (12.2)	2.7 (1.4, 5.3)	.007
HLD	18 (45)	6,302 (28.3)	2.1 (1.1, 3.8)	.02
DVT	5 (12.5)	424 (1.9)	7.4 (3.1, 18.4)	.001
History of Venous Stasis	1 (2.5)	244 (1.1)	2.3 (0.23, 12.8)	.36
Renal Insufficiency	1 (2.5)	168 (0.75)	3.4 (0.33, 18.8)	.26
Therapeutic Anticoagulation	9 (22.5)	662 (3.0)	9.5 (4.5, 19.7)	<.001
Previous Obesity/Foregut Surgery	3 (7.5)	339 (1.5)	5.3 (1.7, 16.2)	.02
Diabetes Mellitus	17 (42.5)	7,866 (35.3)	1.4 (0.74, 2.5)	.41
Tobacco Use	6 (15)	1,894 (8.5)	1.9 (0.86, 4.3)	.15
Non-Independent Functional Status	4 (10)	224 (1.0)	11.0 (4.1, 29.0)	<.001
COPD	5 (12.5)	436 (2.0)	7.2 (3.0, 17.9)	.001
PE	4 (10)	287 (1.3)	8.5 (3.2, 22.5)	.002
OSA	21 (52.5)	9,798 (43.9)	1.4 (0.76, 2.7)	.34
Chronic Steroids	2 (5.0)	374 (1.7)	3.1 (0.73, 11.3)	.15
Previous Organ Transplant	0 (0.0)	17 (0.08)	n/a	1.0
Hematocrit	41.2 (38.4-44.7)(n=39)	40.9 (38.7-43.2)(n=22,060)	n/a	.37
Creatinine	0.90 (0.80-1.18)	0.80 (0.70-0.90)(n=21,845)	n/a	<.001
Bariatric Surgeon	40 (100)	22,019 (98.7)	n/a	1.0

Table 5- Bivariate Analysis of 30-day Mortality

Patient Variable	Prevalence with Composite Endpoint (n=1,623, 7.3%)	Prevalence without Composite Endpoint (n=20,722, 92.7%)	Odds Ratio (95% CI)	P
Albumin (g/dL)	4.0 (3.7-4.3)	4.0 (3.8-4.3)	n/a	.01
Female	1,308 (80.6)	16,658 (80.4)	1.01 (0.89, 1.3)	.87
Age (years)	45.6 (36.6-54.4)(n=1,622)	45.1 (36.2-53.9)(n=20,717)	n/a	.13
Non-white race	318 (21.0)(n=1,517)	3,177 (16.5)(n=19,200)	1.4 (1.2, 1.5)	<.001
Initial BMI (kg/m^2)	44.1 (40.3-50.8)(n=1,617)	44.5 (40.4-50.1)(n=20,630)	n/a	.81
GERD	752 (46.3)	8,133 (39.2)	1.3 (1.2, 1.5)	<.001
Any Cardiac History	94 (5.8)	673 (3.2)	1.8 (1.5, 2.3)	<.001
Severe Hypertension	234 (14.4)	2,505 (12.1)	1.2 (1.06, 1.4)	.007
HLD	525 (32.3)	5,795 (28.0)	1.2 (1.1, 1.4)	<.001
DVT	57 (3.5)	372 (1.8)	2.0 (1.5, 2.6)	<.001
History of Venous Stasis	17 (1.0)	228 (1.1)	0.95 (0.59, 1.6)	1.0
Renal Insufficiency	20 (1.2)	149 (0.7)	1.7 (1.07, 2.7)	.04
Therapeutic Anticoagulation	82 (5.1)	589 (2.8)	1.8 (1.4, 2.3)	<.001
Previous Obesity/Foregut Surgery	47 (2.9)	295 (1.4)	2.1 (1.5, 2.8)	<.001
Diabetes Mellitus	596 (3.7)	7,287 (35.2)	1.07 (0.96, 1.2)	.21
Tobacco Use	146 (9.0)	1,754 (8.5)	1.07 (0.89, 1.3)	.46
Non-Independent Functional Status	29 (1.8)	199 (1.0)	1.9 (1.3, 2.8)	.003
COPD	50 (3.1)	391 (1.9)	1.7 (1.2, 2.2)	.002
PE	40 (2.5)	251 (1.2)	2.1 (1.5, 2.9)	<.001
OSA	765 (4.7)	9,054 (43.7)	1.1 (1.04, 1.3)	.008
Chronic Steroids	55 (3.4)	321 (1.5)	2.2 (1.7, 3.0)	<.001
Previous Organ Transplant	2 (0.1)	15 (0.07)	1.7 (0.39, 6.9)	.35
Hematocrit	40.6 (38.2-43.0)(n=1,610)	40.9 (38.7-43.2)(n=20,489)	n/a	<.001
Creatinine	0.80 (0.70-0.93)(n=1,604)	0.79 (0.70-0.90)(n=20,281)	n/a	<.001
Bariatric Surgeon	1,597 (98.4)	20,462 (98.7)	0.78 (0.52, 1.2)	.25

Table 6- Bivariate Analysis of 30-day Composite Endpoint

Patient Variable	30-day Reoperation (n=21,879)[a]	30-day Readmission (n=20,143)[b]	30-day Reintervention (n=22,099)[c]	30-day Mortality (n=20,229)[d]	30-day Composite Endpoint (n=20,143)[e]
Albumin (g/dL)	1.06 (0.75, 1.2); .65	0.85 (0.72, 0.99); .04	0.94 (0.74, 1.19); .61	0.98 (0.44, 2.2); .95	0.87 (0.76, 0.999); .05
Female	n/a	n/a	n/a	0.45 (0.23, 0.91); .03	n/a
Age (years)	1.0005 (0.992, 1.009); .92	n/a	n/a	1.04 (1.004, 1.07); .03	n/a
Non-white race	n/a	1.3 (1.1, 1.6); <.001	n/a	2.0 (0.96, 4.2); .06	1.3 (1.1, 1.5); <.001
Initial BMI (kg/m^2)	n/a	n/a	n/a	1.06 (1.02, 1.09); <.001	n/a
GERD	1.2 (0.99, 1.4); .06	1.3 (1.2, 1.5); <.001	1.3 (1.07, 1.6); .008	n/a	1.2 (1.1, 1.4); <.001
Any Cardiac History	1.4 (0.91, 2.1); .13	1.3 (0.998, 1.8); .052	1.5 (0.99, 2.3); .07	2.5 (0.94, 6.7); .07	1.6 (1.2, 2.0); <.001
Severe Hypertension	n/a	1.06 (0.52, 0.89); .52	n/a	1.2 (0.53, 2.6); .70	1.01 (0.86, 1.2); .88
HLD	1.3 (0.99, 1.5); .06	1.07 (0.36, 0.93); .36	n/a	1.06 (0.50, 2.3); .88	1.09 (0.96, 1.2); .17
DVT	n/a	1.5 (1.003, 2.1); .05	n/a	2.2 (0.65, 7.5); .21	1.5 (1.06, 2.05); .02
History of Venous Stasis	n/a	n/a	n/a	n/a	n/a
Renal Insufficiency	0.82 (0.31, 2.2); .68	1.1 (0.64, 2.0); .67	n/a	n/a	0.88 (0.52, 1.51); .65
Therapeutic Anticoagulation	n/a	1.01 (0.72, 1.4); .94	1.5 (0.96, 2.4); .09	2.3 (0.88, 6.3); .09	1.1 (0.85, 1.5); .38
Previous Obesity/Foregut Surgery	2.1 (1.3, 3.5); .005	1.8 (1.2, 2.6); .003	2.1 (1.2, 3.5); .02	5.6 (1.6, 19.0); .006	2.0 (1.5, 2.8); <.001
Diabetes Mellitus	n/a	n/a	n/a	n/a	n/a
Tobacco Use	n/a	n/a	n/a	n/a	n/a
Non-Independent Functional Status	n/a	1.7 (1.07, 2.6); .02	n/a	3.7 (1.1, 12.4); .03	1.4 (0.95, 2.2); .09
COPD	1.8 (1.1, 2.8); .02	1.2 (0.82, 1.7); .37	n/a	2.7 (0.98, 7.5); .06	1.2 (0.90, 1.7); .18
PE	n/a	1.5 (0.94, 2.3); .09	n/a	1.8 (0.43, 7.3); .42	1.4 (0.96, 2.1); .08
OSA	n/a	n/a	n/a	n/a	1.06 (0.95, 1.2); .29
Chronic Steroids	2.6 (1.7, 4.0); <.001	1.5 (1.04, 2.2); .03	1.6 (0.95, 2.8); .09	n/a	1.8 (1.3, 2.5); <.001
Previous Organ Transplant	n/a	n/a	n/a	n/a	n/a
Hematocrit	n/a	0.99 (0.97, 1.005); .16	0.98 (0.95, 0.999); .04	n/a	0.99 (0.97, 0.9996); .04
Creatinine	1.1 (0.96, 1.3); .11	1.1 (1.03, 1.23); .009	n/a	1.03 (0.65, 1.6); .91	1.1 (1.04, 1.2); .003
Bariatric Surgeon	n/a	n/a	n/a	n/a	n/a

Table 7- Multivariable Analysis of 30-day Endpoints

Expressed as odds ratio (95% confidence interval); *P* value

[a]*P*<.001; [b]*P*<.001, [c]*P*<.001, [d]*P*<.001,[e]*P*<.001

CONCLUSIONS

Analogous to other general surgical procedures, depressed preoperative serum albumin levels may confer increased risk of 30-day morbidity after LRYGB. Patients are best served being nutritionally replete prior to surgery and prospective studies are needed to assess impact on outcomes.

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